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## The Efficient Capital Market Hypothesis, Chaos Theory, and the Insider Filing Requirements of the Securities Exchange Act of 1934: The Predictive Power of Form 4 Filings

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## COMMENT

# THE EFFICIENT CAPITAL MARKET HYPOTHESIS, CHAOS THEORY, AND THE INSIDER FILING REQUIREMENTS OF THE SECURITIES EXCHANGE ACT OF 1934: THE PREDICTIVE POWER OF FORM 4 FILINGS

*Patrick J. Glen\**

In general we look for a new law by the following process. First we guess it. Then we compute the consequences of the guess to see what would be implied if this law that we guessed is right. Then we compare the result of the computation to nature, with experiment or experience, compare it directly with observation, to see if it works. If it disagrees with experiment it is wrong. In that simple statement is the key to science. It does not make any difference how beautiful your guess is. It does not make any difference how smart you are, who made the guess, or what his name is - if it disagrees with experiment it is wrong. That is all there is to it.<sup>1</sup>

- Richard Feynman<sup>2</sup>

## I. INTRODUCTION

We begin with a guess, or, to clothe the process in the regalia of the academic, a hypothesis. Ours is not a hypothesis about the existence of a yet unobserved quantum particle or the significance of the

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1. RICHARD FEYNMAN, *THE CHARACTER OF PHYSICAL LAW* 150 (The M.I.T Press 1965).

2. Feynman was awarded the Nobel Prize in Physics in 1965 for his groundbreaking work in quantum electrodynamics, one year after making the above cited statement during the Messenger Lectures at Cornell University.

cosmological constant in Einstein's field equations, as Feynman's would have been; but rather about the effect of insider trading on market movement. To streamline this thought, our hypothesis, for purposes of this "experiment", can be phrased as:

There is a distinct movement of the market premised solely on the insider filing requirements concerning transactions altering the beneficial ownership of a security.

Through this hypothesis, we posit a correlation between the receipt of forms (in this case Form 4's) by the Securities and Exchange Commission, and the movement of the subject security on the market. With our hypothesis in hand, we may now compute the logical consequences of that initial idea without benefit of experiment or observation.

At this point, it is worth stating that our hypothesis is broad. If we assume, now, some sort of movement, is that fluctuation based on one Form 4 being filed or on multiple Form 4 filings? Does it matter *who* has filed: Whether it is an officer, a director, or a ten-percent shareholder? These questions have no resolution here. Only after experiment will there be answers. The computation of consequences we need to imagine now is simpler, more fundamental, and capable of greater precision after experiment.

If our hypothesis is correct, then the logical consequences should be apparent. When a Form 4 is filed (or a series of forms are filed on a given day, as the case may be), there should be a market movement related to the status of the transaction. An acquisition by an insider should signal a subsequent rise in the price of the security, while a disposition should signal a decline. The trading of insiders should then, in some form, serve as a trigger for market movement. Whether there is a direct correlation between timing and transactional status on the one hand, and the movement of the market on the other, is yet to be seen. What we do have now, however, is the direction which our observation must follow. All that is left for us is to experiment: to be proven right or wrong.

Yet before embarking on that road and immersing ourselves in numbers, it will be useful to understand both the legal and theoretical frameworks in which we are operating. To that end, Part II lays the legal foundation for the Form 4 reporting requirements under the

Securities Exchange Act of 1934. Part III explores the theoretical framework of economic theory, beginning with an explication of the efficient market hypothesis, and then exploring both the random walk theory and noise theory before settling on the emergence of chaos theory. Part IV contains the experimental portion of the paper, which is undertaken in two parts. The first part represents the initial sample and is analyzed under the broad version of the hypothesis established in Part I. The second part concerns itself with a broader sample class and a hypothesis narrowed by what will be observed in the first part. Finally, Part V attempts to pull all the preceding together, fitting our experimental results into the theoretical frameworks explored in Part III.

## II. THE LEGAL FRAMEWORK

The legal framework, in essence the laws we are concerned with, is relatively simple. The foundation of this framework is the Securities Exchange Act of 1934 (“‘34 Act”).<sup>3</sup> Also relevant, to the extent that they amended the ‘34 Act, are the Sarbanes-Oxley Act of 2002 (“Sarbanes-Oxley”),<sup>4</sup> the Public Utility Holding Company Act of 1935 (“PUHCA”),<sup>5</sup> the Investment Company Act of 1940 (“ICA”),<sup>6</sup> and the relevant rules and regulations under all the above mentioned Acts. Specifically, our concern lies with the Form 4 filing requirements.

Form 4 applies to changes in the beneficial ownership of securities. For any transaction falling within the language of §16(a) of the ‘34 Act,<sup>7</sup>

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3. Securities Exchange Act of 1934, 15 U.S.C. § 78 (2001).

4. Sarbanes-Oxley Act of 2002, Pub. L. No. 107-204, 116 Stat. 745 (2002).

5. Public Utility Holding Company Act of 1935, 15 U.S.C. § 79 (2001).

6. Investment Company Act of 1940, 15 U.S.C. § 80 (2001).

7. The relevant text of the statute is as follows:

(a) Disclosures required.

(1) Directors, officers, and principal stockholders required to file. Every person who is directly or indirectly the beneficial owner of more than 10 percent of any class of any equity security (other than an exempted security) which is registered pursuant to section 12 [15 U.S.C. § 781], or who is a director or an officer of the issuer of such security, shall file the statements required by this subsection with the Commission (and, if such security is registered on a national exchange, also with the exchange).

(2) Time of filing. The statements required by this subsection shall be filed –

(A) at the time of the registration of such security on a national securities exchange or by the effective date of a registration statement filed pursuant to section 12(g) [15 U.S.C. § 781(g)];

(B) within 10 days after he or she becomes such beneficial owner, director, or officer;

§17(a) of PUHCA,<sup>8</sup> or §30(h) of ICA,<sup>9</sup> a Form 4 must be filed in

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(C) if there has been a change in such ownership, or if such person shall have purchased or sold a security-based swap agreement (as defined in section 206(b) of the Gramm-Leach-Bliley Act (15 U.S.C. §78c note)) involving such equity security, before the end of the second business day following the day on which the subject transaction has been executed, or at such other time as the Commission shall establish, by rule, in any case in which the Commission determines that such 2-day period is not feasible.

(3) Contents of statements. A statement filed –

(A) under subparagraph (A) or (B) of paragraph (2) shall contain a statement of the amount of all equity securities of such issuer of which the filing person is the beneficial owner and;

(B) under subparagraph (C) of such paragraph shall indicate ownership by the filing person at the date of filing, any such changes in such ownership, and such purchases and sales of the security-based swap agreements as have occurred since the most recent such filing under such subparagraph.

(4) Electronic filing and availability. Beginning not later than 1 year after the date of enactment of the Sarbanes-Oxley Act of 2002 [enacted July 30, 2002] –

(A) a statement filed under subparagraph (C) of paragraph (2) shall be filed electronically;

(B) the Commission shall provide each such statement on a publicly accessible Internet site not later than the end of the business day following that filing; and

(C) the issuer (if the issuer maintains a corporate website) shall provide that statement on that corporate website, not later than the end of the business day following that filing.

Securities Exchange Act, *supra* note 3, 15 U.S.C. § 78p(a).

8. The relevant text of the statute is as follows:

Statement of ownership of securities; duty to file. Every person who is an officer or director of a registered holding company shall file with the Commission in such form as the Commission shall prescribe (1) at the time of the registration of such holding company, or within ten days after such person becomes an officer or director, a statement of the securities of such registered holding company or any subsidiary company thereof of which he is, directly or indirectly, the beneficial owner, and (2) within ten days after the close of each calendar month thereafter, if there has been any change in such ownership during such month, a statement of such ownership as of the close of such calendar month and of the changes in such ownership that have occurred during such calendar month.

Public Utility Holding Company Act, *supra* note 5, 15 U.S.C. § 79q(a).

9. The relevant text of the statute is as follows:

Duties and liabilities of affiliated persons. Every person who is directly or indirectly the beneficial owner of more than 10 percentum of any class of outstanding securities (other than short-term paper) of which a registered closed-end company is the issuer or who is an officer, director, member of an advisory board, investment adviser, or affiliated person of an investment adviser of such a company shall in respect of his transactions in any securities of such company (other than short-term paper) be subject to the same duties and liabilities as those imposed by section 16 of the Securities Exchange Act of 1934 [15 USCS § 78p] upon certain beneficial owners, directors, and officers in respect of their transactions in certain equity securities.

compliance with the requirements of the regulations.<sup>10</sup> The regulations begin by generally delineating when and where a Form 4 must be filed. The form must be filed within two days of the subject transaction,<sup>11</sup> pursuant to §403 of Sarbanes-Oxley<sup>12</sup> to encourage the public dissemination of previously private information. Three copies of the form must be filed with the Commission,<sup>13</sup> one copy must be filed on each Exchange on which any class of securities of the issuer is registered,<sup>14</sup> and one copy must be filed with the person designated by the issuer, or failing such designation, with the issuer's corporate secretary.<sup>15</sup>

The regulations also specify the class of securities to which the reporting requirements apply.<sup>16</sup> An individual reporting pursuant to §16(a) of the '34 Act must report each transaction resulting in a change of beneficial ownership "of any class of equity securities of the issuer and the beneficial ownership of that class of securities following the reported transaction" even if that class of securities is not registered pursuant to §12 of the '34 Act.<sup>17</sup> An individual reporting pursuant to §17(a) of PUHCA must report each transaction resulting in a change of beneficial ownership "of any class of securities (equity or debt) of the registered holding company and of all its subsidiary companies and the beneficial ownership of that class of securities following the reported transaction."<sup>18</sup> An individual reporting pursuant to §30(h) of ICA must report each transaction resulting in a change of beneficial ownership "of any class of securities (equity or debt) of the registered closed-end investment company . . . and the beneficial ownership of that class of securities following the reported transaction."<sup>19</sup>

There are three main transactions and holdings required to be

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Investment Company Act, *supra* note 6, 15 U.S.C. § 80a-29(h).

10. 17 C.F.R. § 229 (2004); 17 C.F.R. § 230 (2004); 17 C.F.R. § 240 (2004).

11. Securities Exchange Act, *supra* note 3, § 16(c).

12. Amending Section 16 of the Securities Exchange Act of 1934 (15 U.S.C.A. § 78p).

13. 17 C.F.R. § 240.16a-3(a).

14. *Id.* § 240.16a-3(c).

15. *Id.* § 240.16a-3(e).

16. *Id.* § 240.16a-3(g)(1); *see also id.* §240.16a-3(a).

17. SECURITIES REGULATION: SELECTED STATUTES, RULES AND FORMS General Instruction 3[a][i], at 1195 (Hazen ed., West Group 2003) (1982).

18. *Id.* General Instruction 3[a][ii].

19. *Id.* General Instruction 3[a][iii].

reported in accordance with Rule 16a-3(g) of the '34 Act: 1) all transactions not exempt from §16(b);<sup>20</sup> 2) all transactions exempt from §16(b) pursuant to Rule 16b-3(d), Rule 16b-3(e), or Rule 16b-3(f);<sup>21</sup> and

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20. The relevant text of the statute is as follows:

Profits from purchase and sale of security within six months. For the purpose of preventing the unfair use of information which may have been obtained by such beneficial owner, director, or officer by reason of his relationship to the issuer, any profit realized by him from any purchase or sale, or any sale and purchase, of any equity of such issuer (other than an exempted security) or a security-based swap agreement (as defined in section 206B of the Gramm-Leach-Bliley Act [15 USCS § 78c note]) involving any such equity security within any period of less than six months, unless such security or security-based swap agreement was acquired in good faith in connection with a debt previously contracted, shall inure to and be recoverable by the issuer, irrespective of any intention on the part of such beneficial owner, director, or officer in entering into such transaction of holding the security or security-based swap agreement purchased or of not repurchasing the security or security-based swap agreement sold for a period exceeding six months. Suit to recover such profit may be instituted at law or in equity in any court of competent jurisdiction by the issuer, or by the owner of any security of the issuer in the name and in behalf of the issuer if the issuer shall fail or refuse to bring such suit within sixty days after request or shall fail diligently to prosecute the same thereafter; but no such suit shall be brought more than two years after the date such profit was realized. This subsection shall not be construed as to cover any transaction where such beneficial owner was not such both at the time of the purchase and sale, or the sale and purchase, of the security or security-based swap agreement (as defined in section 206B of the Gramm-Leach-Bliley Act [15 USCS § 78c note]) involved, or any transaction or transactions which the Commission by rules and regulations may exempt as not comprehended within the purpose of this subsection.

Securities Exchange Act, *supra* note 3, 15 U.S.C. § 78p(b).

21. The relevant text of the statute is as follows:

(d) Acquisitions from the issuer. Any transaction, other than a Discretionary Transaction, involving an acquisition from the issuer (including without limitation a grant or award), whether or not intended for a compensatory or other particular purpose, shall be exempt if:

(1) The transaction is approved by the board of directors of the issuer, or a committee of the board of directors that is composed solely of two or more Non-Employee Directors;

(2) The transaction is approved or ratified, in compliance with section 14 of the Act, by either; the affirmative votes of the holders of a majority of the securities of the issuer present, or represented, and entitled to vote at a meeting duly held in accordance with the applicable laws of the state or other jurisdiction in which the issuer is incorporated; or the written consent of the holders of a majority of the securities of the issuer entitled to vote; provided that such ratification occurs no later than the date of the next annual meeting of shareholders; or

(3) The issuer equity securities so acquired are held by the officer or director for a period of six months following the date of such acquisition, provided that this condition shall be satisfied with respect to a derivative security if at least six months

3) all exercises and conversions of derivative securities, regardless of whether exempt from §16(b) of the '34 Act.<sup>22</sup> The identification of the nature of each transaction is specified by the use of transaction codes found in Instruction 8 of the Form 4 regulations.<sup>23</sup> If a person with beneficial ownership of a covered security undertakes one of the above listed transactions, they must report the transaction to the S.E.C. Person, as used here, is broad in the normal sense but consistent with the legal definition: person applies to any natural person, whether their ownership is direct or indirect,<sup>24</sup> any trust with relevant holdings,<sup>25</sup> and any corporation, subsidiary, or other legally cognizable entity. Along with the classic transaction involving stock, or non-derivative securities, the regulations also require the reporting of any transaction involving derivative securities, such as puts, calls, options, warrants, convertible securities, or other rights or obligations to buy or sell securities.<sup>26</sup>

The instructions also specify that the price of the stock shall be reported on a per share basis as opposed to in the aggregate,<sup>27</sup> that if the consideration paid or received is not cash, then the consideration must be described,<sup>28</sup> that additional information shall be stated if necessary or relevant;<sup>29</sup> and that the form shall be signed either by an individual in the

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elapse from the date of acquisition of the derivative security to the date of disposition of the derivative security (other than upon exercise or conversion) or its underlying equity security.

(e) Dispositions to the issuer. Any transaction involving the disposition to the issuer of issuer equity securities (other than a Discretionary Transaction) shall be exempt, provided that the terms of such disposition are approved in advance in the manner prescribed by either paragraph (d)(1) or paragraph (d)(2) of this section.

(f) Discretionary Transactions. A Discretionary Transaction shall be exempt only if effected pursuant to an election made at least six months following the date of the most recent election, with respect to any plan of the issuer, that effected a Discretionary Transaction that was:

(1) An acquisition, if the transaction to be exempted would be a disposition; or

(2) A disposition, if the transaction to be exempted would be an acquisition.

17 C.F.R. § 240.16b-3(d-f).

22. *Id.*

23. Hazen, *supra* note 17, General Instruction 8, at 1198.

24. 17 C.F.R. § 240.16a-2.

25. *Id.* § 240.16a-8.

26. *Id.* § 240.16a-4.

27. Hazen, *supra* note 17, General Instruction 5(a), at 1198.

28. *Id.* General Instruction 5(b).

29. *See id.* General Instruction 6.



individual's interest,<sup>30</sup> or, if on behalf of a corporate or other entity, by the individual including the capacity in which he signed.<sup>31</sup>

### III. THE THEORETICAL FRAMEWORK

This paper being concerned not only with the nature of the Form 4 filing requirements, but also with the effects of those requirements on the market, the legal framework serves only as a foundation. To augment this, there are four theoretical approaches to the market which this paper contemplates: the efficient capital market hypothesis, the random walk theory, noise theory, and chaos theory. Because it is important not only to understand the strictly legal requirements of the securities laws but also the potential effect they might have on the movement of capital markets, each theory will be dealt with here in turn.

#### A. THE EFFICIENT CAPITAL MARKET HYPOTHESIS

The efficient market hypothesis (EMH) came to the forefront of economic theory on the strength of empirical tests in large part undertaken by finance theorist Eugene Fama.<sup>32</sup> These statistical tests demonstrated that "the market prices securities *as if* there was a rational process, whether or not the market's constituent actors qualify as rational."<sup>33</sup> In fact, the EMH can be seen as "the natural consequence of thinking about financial asset prices as an equilibrium in a competitive market consisting of rational actors. Indeed, there is almost a tautological character to some forms of the hypothesis once rationality is assumed."<sup>34</sup>

The EMH, in its relevant aspect, "states that competition between sophisticated investors enables the stock market consistently to price stocks in accordance with our best expectations of the long-term

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30. See 17 C.F.R. §240.16a-3(i) (2003).

31. See *id.*

32. See EUGENE F. FAMA, FOUNDATIONS OF FINANCE (Basic Books 1976); Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, 25 J. FIN. 383 (1970).

33. Donald C. Langevoort, *Theories, Assumptions, and Securities Regulation: Market Efficiency Revisited*, 140 U. PA. L. REV. 851, 852 (1992).

34. *Id.* at 857.

earnings of the underlying businesses and assets.”<sup>35</sup> To be “efficient”, the prices in a given market must always “‘fully reflect’ available information.”<sup>36</sup> There are three basic categories of market efficiency under the EMH:

1. Weak form, in which the information set is just historical prices.
2. Semi-strong form, in which the concern is whether prices efficiently adjust to other information that is obviously publicly available.
3. Strong form, in which the concern is whether given investors or groups have monopolistic access to any information relevant for price formation.<sup>37</sup>

As the EMH applies to this comment, we are concerned with numbers 2 and 3. In essence, the strong form, if true, would state that even insider information would not aid an investor because the market price would reflect not only all public information, but *all possible* information concerning that security. This conception has largely been falsified already, an outcome that hardly could have surprised Fama, who stated in 1970, concerning the strong form, that “[o]ne would not expect such an extreme model to be an exact description of the world, and it is probably best viewed as a benchmark against which the importance of deviations from market efficiency can be judged.”<sup>38</sup> The semi-strong form is also of interest, because if it is true it would seem, then, that the only significant movement in relation to Form 4 requirements would occur between the trading day and the filing day, when the information concerning the transaction becomes public. This will be discussed further in Part V.

It has already been stated that an efficient market is one where the prices of securities fully reflect all available information, but then what are the sufficient conditions for capital market efficiency? In an

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35. Louis Lowenstein, *Pruning Deadwood in Hostile Takeovers: A Proposal for Legislation*, 83 COLUM. L. REV. 249, 269 (1983).

36. Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, *supra* note 32, at 384.

37. *Id.*

38. *Id.* at 414.

idealized world, such conditions would be:

1. No transaction costs in trading securities.
2. All available information is available without cost to all market participants.
3. All agree on the implications of current information for the current price and distributions of future prices of each security.<sup>39</sup>

Frictionless markets, however, do not exist in the real world, and in any market there will be a combination of transactional costs, costly information, and disagreement concerning the information that is commonly held. A large part of the EMH is measuring the effect that these three factors have on the efficient allocation of price in free markets.<sup>40</sup>

Furthermore, efficiency, as it pertains to the EMH, can be further broken down into two aspects: price efficiency and market efficiency. Price can be considered efficient in two senses: "1) the current price of a security best predicts its future price and 2) the prevailing price immediately assimilates new information provided to the market."<sup>41</sup> To do this, "[t]he mechanism of price formation somehow captures information about and predicts the future payment of a security as well as about the investor who happens to know, with concrete particularity, of this relevant information."<sup>42</sup> Market efficiency is thus premised on the claim that "all relevant information will be available to the market and that the market rapidly, if not instantaneously, digests all information as it becomes available."<sup>43</sup>

A market may be speculatively or allocatively efficient (or both). The categorization of efficiency in this context depends on what type of return the market accurately reflects: real or financial. The notions of real and financial returns are further premised on the two main functions capital markets serve: the shifting of consumption and the allocation of

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39. *Id.* at 387.

40. *See id.* at 388.

41. Jeffrey N. Gordon & Lewis A. Kornhauser, *Efficient Markets, Costly Information, and Securities Research*, 60 N.Y.U. L. REV. 761, 770 (1985).

42. *Id.*

43. *Id.* at 770-71.

investment funds.<sup>44</sup> To make a “good” decision in the shifting of consumption, an individual needs to know the financial returns of the planned shift – “the payout of dividends or interest and capital gain or loss.”<sup>45</sup> A market that induces “good” decisions in the shifting of consumption is speculatively efficient.<sup>46</sup> To make a “good” decision regarding the allocation of investment funds, an individual needs to know the real returns – gross revenue less costs of production.<sup>47</sup> A market that induces good allocation of investment funds is said to be allocatively efficient.<sup>48</sup> A market that accurately reflects both real and financial returns is both allocatively and speculatively efficient. The EMH, however, concerns itself only with speculative efficiency.<sup>49</sup> Although there is a connection between real and financial returns insofar as “dividends and interest are linked to real economic outputs in that a company must generate profits to make such payouts, there is no necessary connection between changes in security prices and economic outputs.”<sup>50</sup> The EMH states only that prevailing prices reflect, with some degree of variance, future prices. This is conducive to an analysis of financial returns, but not of real returns, which would examine the underlying assets represented by the security.

The EMH is of interest in this paper for two reasons. First, as previously stated, the subject matter of this paper represents an opportunity to gauge whether the strong form deserves any credence. If there is significant movement following insider trades, it should be obvious that prices do not take inside information into account. The second reason is slightly more nuanced. Because of the S.E.C. requirements and the amendments under Sarbanes-Oxley, the Form 4 itself becomes public information within two days of the transaction it covers. According to the EMH, a security’s price should reflect the dispersion of this information. The effect should be consistent with the information of the form – namely, if an insider acquires or disposes of a security, and the form becomes public, that information should lead to an adjustment in the security’s price commensurate with the insider

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44. *Id.* at 767.

45. *Id.*

46. Jeffrey N. Gordon & Lewis A. Kornhauser, *supra* note 41, at 767.

47. *Id.*

48. *Id.*

49. *Id.* at 771.

50. *Id.* at 827.

information. If the EMH is correct in its semi-strong form, then the only significant movement pertaining to the filing of Form 4's should occur in the period between the date of the trade and the date of filing, prior to the time when the information becomes public and the market assimilates this information into its pricing mechanism.

### B. RANDOMNESS, NOISE, AND THE EMERGENCE OF CHAOS THEORY

The present day criticisms of the EMH notwithstanding, even during its period of greatest acceptance, there were still rival theories concerning the movement of market prices. Two of these, the random walk theory and noise theory, are worth exploring because they move away from the underlying notions of the EMH and foreshadow the emergence of chaotic analysis in economics.

#### 1. THE RANDOM WALK THEORY

The random walk theory arose as a rationalization for underlying empirical data concerning market movement. Although the model dates to the dissertation of French mathematician Louis Bachelier<sup>51</sup> and the work, five years later, of Albert Einstein<sup>52</sup> concerning what would become known as Brownian motion,<sup>53</sup> the "impetus for the development of a theory came from the accumulation of evidence in the middle 1950's and early 1960's that the behavior of common stock and other

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51. LOUIS BACHELIER, *THEORY OF SPECULATION, IN THE RANDOM CHARACTER OF STOCK MARKET PRICES* (Paul H. Cootner ed., Cambridge: MIT Press 1964).

52. Albert Einstein, *On The Motion Of Small Particles Suspended In Liquids At Rest Required By The Molecular-Kinetic Theory Of Heat*, *Annalen der Physik* (1905). Interestingly, Einstein's paper on Brownian motion appeared in the same volume of *Annalen der Physik* as his *Special Theory of Relativity*.

53. Brownian motion, a random, irregular motion of small particles of dust suspended in a liquid, is named after Dr. Robert Brown (1773-1858), a Scottish botanist who was the first to observe the phenomenon. Einstein's explanation of Brownian motion as the effect of atoms of the liquid colliding with dust particles provided important physical evidence in favor of the atomic view of reality as opposed to the view that matter could be infinitely divided, a notion derived from the Aristotelian belief that matter was continuous. STEPHEN HAWKING, *A BRIEF HISTORY OF TIME* 63-64 (Rei Edition, Bantam 1988).

speculative prices could be well approximated by a random walk.”<sup>54</sup> As a logical extension of those studies, “many economists thought that there is no pattern to the price history of a security and therefore that there can be no accurate prediction of future changes in security prices based on prior prices.”<sup>55</sup> The theory does not in fact posit absolute randomness in the movement of security prices, or “that stock prices move aimlessly and erratically and are insensitive to changes in fundamental information.”<sup>56</sup> Rather, the theory “maintains that the market is efficient, with prices moving so rapidly in response to new information that investors cannot consistently buy or sell fast enough to benefit.”<sup>57</sup>

In this sense, the random walk theory is closely related to both the weak and semi-strong forms of the efficient market hypothesis. However, while they are consistent in outcomes, their underlying logic differs. Concerning the weak form, it is posited that all past data is reflected in present market prices. The random walk, however, divorces entirely the present from the past: “In a random walk process, each step is made independently of preceding steps.”<sup>58</sup> In either case, an investor cannot benefit except by luck, but the inability to consistently benefit from either a weak form efficient or random market rests on differing presuppositions. Moreover, the semi-strong form prices reflect all available information. Therefore, investors in the “semi-strong” world will all be on equal footing. Under a random walk theory, the same will occur, but only because information changes on a random basis, and stock prices follow a similarly random pattern.<sup>59</sup>

## 2. NOISE THEORY

The hallmark of the EMH is its belief in the rationality of human beings. This is consistent with the conventional economic model which

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54. Eugene F. Fama, *Efficient Capital Markets: A Review of Theory and Empirical Work*, *supra* note 32, at 389.

55. Lawrence A. Cunningham, *From Random Walks to Chaotic Crashes: The Linear Genealogy of the Efficient Capital Market Hypothesis*, 62 GEO. WASH. L. REV. 546, 551 (1994).

56. Thomas Lee Hazen, *The Short-Term/Long-Term Dichotomy and Investment Theory: Implications for Securities Market Regulation and for Corporate Law*, 70 N.C. L. REV. 137, 157 (1991).

57. *Id.*

58. TONIS VAGA, *PROFITING FROM CHAOS* 85 (McGraw-Hill Professional 1994).

59. *Id.* at 67.

“postulates that rational decision-makers search for the option having the largest subjective expected utility, determined by reference to probabilities derived from the available information set.”<sup>60</sup> Economists have long resisted the possibility that human beings may act irrationally in the market setting, in large part accounting for the foundational stone of rationality in the EMH.<sup>61</sup> Irrational behavior that interferes with market efficiency has become known as “noise.”<sup>62</sup>

Noise, defined more narrowly, refers to those pricing influences that are not associated with rational expectations about the underlying value of the asset.<sup>63</sup> The fact that such expectations are not necessarily rational should not, however, lead to the conclusion that they are in fact irrational. Investment strategies based on non-rational information may represent anything from loyalty to a friend to a personal heuristic. The noise theory is not so concerned with why individuals evidence these sub-optimal behaviors,<sup>64</sup> but rather the effect that it has on the market. Noise theory models “hold that the public capital markets are infected by a substantial volume of trading based on information unrelated to fundamental asset values.”<sup>65</sup> These trades are largely undertaken due to underlying emotional or psychological impulses unrelated to the asset’s value.<sup>66</sup> “Moreover, most investors do not have the capacity or inclination to make comparative investment decisions independently, making them susceptible to external expressions of experts and peer[s].”<sup>67</sup> In the end, “even if a public capital market is efficient in the sense of swiftly incorporating public information into security prices . . . , that does not necessarily mean that securities prices in that market

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60. Langevoort, *supra* note 33, at 858.

61. Cunningham, *supra* note 55, at 565.

62. Hazen, *supra* note 56, at 157.

63. Langevoort, *supra* note 33, at 854.

64. This statement is not entirely correct. Some noise theory models do advance the notion that noise-trading is conducted by ill-informed investors. This is a nice theory, and it fits the “model” universe well, but the reality of the situation is most likely much more complicated. Just as in the scope of this paper the act of filing one Form 4 may signify nothing because the act is tied to personal rather than economic rationale, non-rational or sub-optimal behavior in a capital market is likely to have more complex reasons than ill-informed investors.

65. Cunningham, *supra* note 55, at 565.

66. Lawrence A. Cunningham, *Capital Market Theory, Mandatory Disclosure, and Price Discovery*, 51 WASH. & LEE L. REV. 843, 853 (1994).

67. Langevoort, *supra* note 33, at 868.

reflect fundamental values.”<sup>68</sup>

Although noise theory has recently received extra attention, the notion itself is old, dating at least to John Maynard Keynes.<sup>69</sup> Keynes assumed that investors on the whole were not conducting fundamental analysis, but rather, were more apt to act based on information unrelated to the fundamental value of the particular asset.<sup>70</sup> The central notion of noise theory is that the prices of capital assets are driven by information unrelated to fundamental values. However, this is not its most important contribution to modern economic analysis. The “more important implication of noise theory is that it reveals markets to be nonlinear systems, to which the linear mathematics and reasoning that underlie the [EMH] are inapposite.”<sup>71</sup> The move towards nonlinear systems paved the way for the emergence of chaos theory.

### 3. THE EMERGENCE OF CHAOS THEORY

Henri Poincaré, a French mathematician, was the first person to see and understand the ramifications of chaotic systems.<sup>72</sup> This “discovery” of chaos arose from Poincaré’s study of the motion of an asteroid under the gravitational influences of the sun and Jupiter.<sup>73</sup> This work represented intensive study of the Newtonian three-body problem.<sup>74</sup> The three-body problem is tied to Newton’s law of gravity. As Brian Greene writes, Newton’s “‘law of gravity’ can be used to predict the motion of planets and comets around the sun, the moon about the earth, and rockets heading off for planetary explorations, as well as more earthbound applications such as baseballs flying through the air and

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68. Cunningham, *supra* note 55, at 563.

69. JOHN MAYNARD KEYNES, *THE GENERAL THEORY OF EMPLOYMENT INTEREST AND MONEY* (Macmillan Cambridge University Press 1935).

70. Langevoort, *supra* note 33, at 866 (“Keynes hypothesized that investors were playing a game akin to the newspaper beauty contests of the time, where readers voted for the most attractive contestant and the winners of the pool came from those who voted for the entrant who received the most votes. Under those circumstances the strategy was not to vote for the one the voter considered most attractive [fundamental analysis], but simply to try to guess for whom the other voters would vote.”).

71. Cunningham, *supra* note 66, at 853-54.

72. PAUL BLANCHARD ET AL., *DIFFERENTIAL EQUATIONS* 478 (Brooks/Cole Publ’g Co. 1998).

73. *Id.* at 487.

74. *Id.* at 199.



divers spiraling poolward from springboards.”<sup>75</sup> Newton’s law, however, applies only to two bodies in space. As Poincaré realized, systems with three dependent variables can have behavior so complicated that the physical drawing of a solution curve would be a truly daunting task.<sup>76</sup> In fact, science has not attempted to calculate future positions and velocities for three bodies. Poincaré’s insight into the chaotic environment of the three-body problem gave rise to the foundational concept of chaos theory: “sensitive dependence on initial conditions.”<sup>77</sup>

It may be useful to understand formal chaos theory before reviewing the applications of chaos to economic theory. For a sense of security, “those who try to explain the world we live in always hope that in the realm of complexity and irregularity observed in nature, simplicity would be found behind everything and, that, finally, unpredictable events would become predictable.”<sup>78</sup> Chaos is “mathematically defined as ‘randomness’ generated by simple deterministic systems.”<sup>79</sup> It seems that titling a theory of deterministic systems “chaos” would be a misnomer, but the name fits. “Even though defined in purely deterministic terms, dynamical systems from . . . economics . . . may behave in quite a complicated and unpredictable manner, so that when looking at such systems we could easily get the impression of watching an experiment of *chance*.”<sup>80</sup> The mere fact that the subject systems are deterministic implies some sense of order.<sup>81</sup> What must at all times be kept in mind is that chaos does not imply randomness. Chaos implies some underlying complex pattern or solution, not mere irregularity.<sup>82</sup> In

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75. BRIAN GREENE, *THE ELEGANT UNIVERSE* 55 (W.W. Norton & Co. 1999).

76. Blanchard, *supra* note 72, at 199.

77. Cunningham, *supra* note 55, at 582.

78. ANASTASIOS A. TSONIS, *CHAOS: FROM THEORY TO APPLICATIONS* 3 (Kluwer Academic Publishers 1992).

79. *Id.*

80. ARNO BERGER, *CHAOS AND CHANCE: AN INTRODUCTION TO STOCHASTIC ASPECTS OF DYNAMICS* 1 (Walter de Gruyter GmbH & Co. KG 2001).

81. Tsonis, *supra* note 78, at 3.

82. Hazen, *supra* note 56, at 159-60 (“In chaos theory, an emerging field in the science of nonlinear dynamics, one finds a hidden pattern in seemingly random events, order in what appears to be disorder, predictability in apparent irregularity.” . . . [C]haos theory maintains that what appears to be random is not, and that patterns may be discerned.”); see Cunningham, *supra* note 66, at 854 (“Chaos theory originated in the study of physics to describe complex systems that have the appearance of irregularity

fact, a process classified as chaotic is treated as deterministic rather than random.<sup>83</sup>

To begin with, it may be useful to understand chaos theory in economics as a function of its differences with established economic theory. Chaos theory advances the notion that the “‘linear frame of reference’ which the EMH rests upon is insufficient to explain market behavior.”<sup>84</sup> Like noise theory, it “criticizes EMH’s simplistic informational approach by suggesting that other factors such as firm fundamentals, macroeconomic factors, and differentiated time dimensions affect prices of securities.”<sup>85</sup> Chaos theory was immediately lent at least intuitive credence by its ability to explain chaotic events, such as market crashes, and by its criticism of the EMH for its purported inability to explain such events.<sup>86</sup> The inability of the EMH to account for chaotic market events is not, however, the only point of contention between the two theories. The most important revelation of chaos theory strikes directly at the heart of the EMH’s account of the absorption of information in securities prices. Using the nonlinear techniques of chaos theory in empirical studies, the results tend to show that “information is not immediately absorbed by market prices, as the E[ ]MH and noise theory both predict; rather, such information remains useful for periods of up to four years.”<sup>87</sup> Because information can be utilized by market participations, and that information is not immediately absorbed into the prices of securities, the possession of such information becomes extremely important.<sup>88</sup> This fact undermines not only the semi-strong and strong versions of the EMH, but even the

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and randomness, but that upon careful inspection reveal order and pattern . . . . A chaotic system is one that seems random on the surface, but that turns out to be nonrandom upon more critical inspection.”); Mark J. Roe, *Chaos and Evolution in Law and Economics*, 109 HARV. L. REV. 641, 642 (1996) (“Chaos here does not mean disorder, but that accurate predictions about where a system is headed are hard. The initial rule orders the microchanges we first observe, but twists and turns can ordain results far from those originally expected.”).

83. Tsonis, *supra* note 78, at 4.

84. Trig R. Smith, *The S.E.C. and Regulation of Foreign Private Issuers: Another Missed Opportunity at Meaningful Regulatory Change*, 26 BROOK. J. INT’L L. 765, 784 (2000).

85. *Id.*

86. *Id.* at 781-85.

87. Cunningham, *supra* note 66, at 855-56.

88. *Id.* at 856.

weak, because the logical conclusion of the continued importance of information means that it retains such importance even after trades occur based on such information.<sup>89</sup>

The import of chaos theory to economics is thus twofold. First, counter to the absorption of information thesis of the EMH, chaos theory posits the existence of "deeper structural phenomena"<sup>90</sup> that affect market movement. Second, the original conditions of any system deeply affect the movement of that system, even after those underlying conditions are gone.<sup>91</sup> Although chaos theory to this point has been utilized almost exclusively for analyses of crashes,<sup>92</sup> it is likely that it will have greater utility in the future. As Tsonis poses the question, "would it be possible that the underlying determinism of such processes could be used to improve their otherwise limited predictability?"<sup>93</sup> At least two individuals think there is hope for greater application of chaos theory to market movement: Tonis Vaga, who states that "in financial markets, the new science of complexity offers the hope of more complete explanation of complex market dynamics, improved investment performance and better management of investment risk,"<sup>94</sup> and Lawrence Cunningham, who argues that:

[P]erformance of financial markets over time should not be mapped as simple random walks, but instead may exhibit hidden patterns of order and predictability that can account for market crashes and provide better rationales for such basic corporate and securities law doctrines as mandatory disclosure rules and mandatory fiduciary obligations.<sup>95</sup>

#### IV. EXPERIMENT, OBSERVATION, AND RESULTS

The experimental aspect of the present comment was undertaken in

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89. *Id.*

90. Cunningham, *supra* note 55, at 593.

91. Roe, *supra* note 82, at 663.

92. Smith, *supra* note 84, at 785.

93. Tsonis, *supra* note 78, at 4.

94. Vaga, *supra* note 58, at 12.

95. Nancy Levit, *Symposium on the Trends In Legal Citations and Scholarship: Defining Cutting Edge Scholarship: Feminism and Criteria of Rationality*, 71 CHIKENT L. REV. 947, 965-66 (1996).

two parts. The first was a limited sample of five companies, the purpose being to streamline as much as possible the original hypothesis. Once this was accomplished, and the observational view narrowed, the test group could be broadened. To that end, the second part was an examination of one hundred four companies, looking solely to days on which more than one Form 4 had been filed.

All companies surveyed are trading on the Nasdaq Smallcap Market. This means that initially these companies had: 1) stockholders' equity of at least \$5 million, or market value of listed securities of at least \$50 million, or net income from continuing operations (in latest fiscal year or two of the last three fiscal years) of at least \$750,000;<sup>96</sup> 2) at least one million publicly held shares;<sup>97</sup> 3) a market value of at least \$5 million for publicly held shares;<sup>98</sup> 4) a minimum bid price of \$4.00;<sup>99</sup> 5) at least 300 shareholders;<sup>100</sup> 6) three market makers;<sup>101</sup> 7) at least a one year operating history or a market value of at least \$50 million for listed securities;<sup>102</sup> and 8) corporate governance under Marketplace Rules 4350, 4351 and 4360.<sup>103</sup> For continued listing these companies

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96. NASDAQ LISTING REQUIREMENTS AND FEES 5 (2005).

97. *Id.*

98. *Id.*

99. *Id.*

100. *Id.*

101. *Id.* See also U.S. Securities and Exchange Commission, <http://www.sec.gov/answers/mktmaker.htm> (last visited Sept. 30, 2005) ("A 'market maker' is a firm that stands ready to buy or sell a particular stock on a regular and continuous basis at a publicly quoted price. You'll most often hear about market makers in the context of the Nasdaq or other 'over the counter' (OTC) markets . . . . Many OTC stocks have more than one market maker. Market makers generally must be ready to buy and sell at least 100 shares of a stock they make a market in. As a result, a large order from an investor may have to be filled by a number of market makers at potentially different prices.").

102. NASDAQ, *supra* note 96.

103. *Id.* Rule 4350 is titled "Qualitative Listing Requirements for Nasdaq National Markets and Nasdaq Smallcap Market Issuers Except for Limited Partnerships." It addresses the distribution of annual and interim reports (4350(b)), independent directors (4350(c)), audit committees (4350(d)), shareholders meetings (4350(e)), the solicitation of proxies (4350(g)), conflicts of interest (4350(h)), shareholder approval (4350(i)), peer review concerning an audit by an independent accountant firm (4350(j)), notification in the event of material non-compliance with applicable listing rules (4350(m)), and the adoption of a code of conduct consistent with the Marketplace Rules (4350(n)). National Association of Securities Dealers, Manual § 4350. Rule 4351 deals

must have: 1) stockholders' equity of at least \$2.5 million, or market value of listed securities of at least \$35 million, or net income from continuing operations (in the latest fiscal year or two of the last three fiscal years) of at least \$500,000;<sup>104</sup> 2) at least five hundred thousand publicly held shares;<sup>105</sup> 3) a market value of at least \$1 million for publicly held shares;<sup>106</sup> 4) a minimum bid price of \$1.00;<sup>107</sup> 5) at least 300 shareholders;<sup>108</sup> 6) two market makers;<sup>109</sup> and 7) corporate governance under Marketplace Rules 4350, 4351 and 4360.<sup>110</sup>

### A. A BROAD HYPOTHESIS AND THE INITIAL SAMPLE

The five companies initially surveyed were Auburn National Bancorporation Inc.,<sup>111</sup> United Security Bancshares Inc.,<sup>112</sup> First of Long Island Corporation,<sup>113</sup> Summit Financial Corporation,<sup>114</sup> and Phazar

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solely with voting rights:

Voting rights of existing shareholders of publicly traded common stock registered under Section Twelve of the Act cannot be disparately reduced or restricted through any corporate action or issuance. Examples of such corporate action or issuance include, but are not limited to, the adoption of time-phased voting plans, the adoption of capped voting rights plans, the issuance of super-voting stock, or the issuance of stock with voting rights less than the per share voting rights of the existing common stock through an exchange offer.

*Id.* § 4351.

104. NASDAQ, *supra* note 96.

105. *Id.*

106. *Id.*

107. *Id.*

108. *Id.*

109. *Id.* See *supra* note 101.

110. *Id.* See *supra* note 103.

111. Auburn National Bancorporation Inc. is a bank holding company registered with the Board of Governors of the Federal Reserve System under the Bank Holding Company Act of 1956, as amended. Auburn has 3,850,000 shares outstanding and a market value of \$87,587,500.

112. United Security Bancshares Inc. is a Delaware Corporation organized in 1999, as a successor by merger with United Security Bancshares Inc., an Alabama Corporation. Bancshares is a bank holding company registered under the Bank Holding Company Act of 1956, as amended. United has 6,430,000 shares outstanding and a market value of \$191,292,500.

113. The First of Long Island Corporation, a one bank holding company, was incorporated on February 7, 1984 for the purpose of providing financial services through its wholly owned subsidiary, The First National Bank of Long Island. First has 4,097,000 shares outstanding and a market value of \$191,616,690.

Corporation.<sup>115</sup> The period of comparison for Form 4 filings and market price was January 14, 2004 to January 14, 2005. Between the five companies over this time period, 210 Form 4's were filed covering 416 transactions. Auburn National had at least one Form 4 filed on twenty-five days during this period, United Security on fourteen days, First of Long Island on thirty-three days, Summit on twenty days, and Phazar on twenty days.

The present conception of the hypothesis is concerned with market movement following the day on which at least one Form 4 is filed.

### 1. AUBURN NATIONAL BANCORPORATION

During the subject period, forty-five Form 4's were filed on twenty-five separate days covering fifty-five transactions. Of these fifty-five transactions, fifty-one were acquisitions and four were dispositions. First, concerning the dispositions, only three are relevant, because one is a gift for no consideration. Of these three, only one shows market movement consistent with the hypothesis, but even that movement is eliminated by a rise in price two days after the transaction, which brought the price back to the original at the time of trade. Concerning the acquisitions, there is market movement consistent with the hypothesis only following the four forms filed on January 7, 2005 and the two forms filed on August 3, 2004. There is no correlation between the other forty-five acquisitions and market movement. In fact, most of the time, the price actually decreased following an acquisition by an insider.

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114. Summit Financial Corporation, headquartered in Greenville, South Carolina, was incorporated as a bank holding company under the Bank Holding Company Act of 1956, as amended, and under the laws of the State of South Carolina on May 26, 1989. The Company became a financial holding company on March 23, 2000 as provided by the "Gramm-Leach-Bliley" Financial Services Modernization Act of 1999. Summit has 4,478,000 shares outstanding and a market value of \$102,904,440.

115. Phazar Corporation operates as a holding company with Antenna Products Corporation, Tumche Corp., Phazar Antenna Corp. and Thirco, Inc. as its subsidiaries. Antenna Products Corporation, and Phazar Antenna Corp. are operating subsidiaries with Thirco, Inc. serving as an equipment leasing company to Phazar Corporation's operating units. Phazar Corporation has no other business activity. Phazar has 2,250,000 shares outstanding and a market value of \$36,270,000.

## 2. UNITED SECURITY BANCSHARES INC.

During the subject period, thirty-six Form 4's were filed on fourteen separate days covering thirty-nine transactions. Of these thirty-nine transactions, thirty-seven were acquisitions and two were dispositions. First, concerning the dispositions, both occurred on August 16, 2004, and were covered in the same filing. The price subsequent to this filing remains virtually unchanged, oscillating negligibly around the price of disposition. Concerning the acquisitions, there is movement consistent with the hypothesis following the six forms filed on July 2, 2004 and the two forms filed on May 24, 2004. All other acquisitions show a subsequent decline in price following the report of the transaction.

## 3. FIRST OF LONG ISLAND CORPORATION

During the subject period, fifty-five Form 4's were filed on thirty-three separate days covering 156 transactions. Of these 156 transactions, 33 were acquisitions and 123 were dispositions. Concerning the dispositions, it seems that there are correlative trends. The market generally declined after the filings on December 14, 2004 (covering fourteen dispositions), December 10 (covering eighteen), December 9 (covering nineteen), December 7 (covering eleven), December 3 (covering three), March 9 (covering four), February 23, February 20, and February 12 (covering twelve). There are only four acquisitions that display consistency; those covered by the forms filed on December 10, 2004, November 24, August 24, and March 8. The transactions of the Chairman of the Board dominate the dispositions, many as they are in number. At this point, it is unclear if this is irrelevant or if it represents a chance for greater precision in the hypothesis; namely, whether the *who* is important. Also, the dispositions are included not necessarily because of immediate movement, but because of the sharp decline at the end of January. Considering the volume and price of the above listed transactions, they should be termed consistent even if not by the "letter" of the hypothesis.

## 4. SUMMIT FINANCIAL CORPORATION

During the subject period, twenty-four Form 4's were filed on twenty separate days covering twenty-nine transactions. Of these

twenty-nine transactions, sixteen were acquisitions and thirteen were dispositions. Concerning the dispositions, there is consistent movement following the form filed on June 15, 2004 (covering two transactions), the form filed on June 7, the disposition covered in the form filed on March 3, and the disposition covered in the form filed on February 24. The other eight dispositions showed no correlation. The acquisitions were all somewhat uninteresting. The forms filed during the subject period covered either the exercise of options or the granting of stock for compensation. The exercise price on the options was far below the market price on the day exercised, and even if something could be read into this, the price usually declined anyway. The stock granted for compensation was done with a base equal to the price at close on the day of the board meeting. There was no movement concerning this stock subsequent to the filing of the relevant form.

#### 5. PHAZAR CORPORATION

During the subject period, fifty Form 4's were filed on twenty separate days covering 137 transactions. Of these 137 transactions, 36 were acquisitions and 101 were dispositions. Concerning the dispositions, four of the forms filed show consistency with the hypothesis, namely those filed on January 12, 2005 (covering seven dispositions), January 11, October 14, 2004, and October 6, 2004 (covering two). Concerning acquisitions, there was only movement following the five forms filed on October 4, 2004 and the two forms filed on August 9.

#### 6. COMPARING THE DATA TO THE HYPOTHESIS

Considering the five companies together, there was movement consistent with the hypothesis on 23.2% of the filing days surveyed (26 of 112) covering 20% of the filed forms (42 of 210) and 24% of the total transactions (124 of 516). The percentage correlation between days subsequent to which the market moved is consistent with the hypothesis, and the percentage of transactions acting as "triggers" for that movement is interesting. Additionally, it is worth noting that the percentage of actual forms acting as such would be significantly higher if an individual form had to be filed for each distinct transaction. Although this information seems to lend credence to the initial hypothesis, a narrowing



is possible based on the information gained. In the end, if we wish to use the filing of Form 4's as a predictive tool for market acquisitions and dispositions, a correlation greater than 20% would be necessary.

In the initial experiment, the examination was concerned with all filings. The narrowing of our subject class is consistent with an idea that was apparent at the beginning; on the whole, one form being filed is not reflective of possible subsequent movement. If a sole insider enters into a transaction whereby his beneficial ownership in a security is altered, can that on the whole serve as a predicate to market movement? No, and there are a variety of reasons. Just as in society as a whole, singular occurrences are not necessarily representative of wider trends. If a director decides to acquire more stock at a specific time it could be for a variety of reasons far removed from a desire to take advantage of possible movement. Perhaps now is just the right time to increase holdings. In addition, a disposition could be for any number of reasons; personal resources might be stretched too thin, perhaps an abnormally large expenditure is on the horizon, and so on. There are too many variables concerning *why* an insider, on his own, might file a Form 4.

To narrow our hypothesis, we merely tighten the class. Trends are more apparent *en masse*, and so instead of examining every Form 4 filed, it may be useful to examine only those filing days when two or more forms are filed. Even this may be subject to the above critique, but it narrows the possibility of the confluence of circumstances – as the trigger becomes more specific, it is less likely that the trading is based on personal reasons and more likely that it has an economic foundation in the underlying security.

### B. A NARROWED HYPOTHESIS AND A BROADER SAMPLE

With our hypothesis narrowed, we must now examine a larger sample of companies under our tightened parameters. Our sample is 104 companies,<sup>116</sup> all located on the Nasdaq Small-Cap Market, and analyzed

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116. 24/7 Real Media, Inc. (TFSM); 724 Solutions, Inc. (SVNX); 8x8, Inc. (EGHT); A Consulting Team, Inc. (TACX); Aastrom Biosciences, Inc. (ASTM); Access Anytime Bancorp, Inc. (AABC); Ace Comm Corporation (ACEC); Action Products International, Inc. (APII); ADA-ES, Inc. (ADES); Advanced Environmental Recycling Technologies, Inc. (AERTA); Aerogen, Inc. (AEGN.OB); Air T, Inc. (AIRT); Alanco Technologies, Inc. (ALAN); Alfacell Corporation (ACEL); Alliance Bankshares Corporation (ABVA); Alliance Fiber Optic Products, Inc. (AFOP); Allied Motion

over the period of February 18, 2004 to February 18, 2005. During this period, 1637 forms were filed on 432 days covering 3499 transactions.

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Technologies, Inc. (AMOT); Altair Nanotechnologies, Inc. (ALTI); AltiGen Communications, Inc. (ATGN); America Online Latin America, Inc. (AOLAQ.PK); American Access Technologies, Inc. (AATK); American Bank, Inc. (AMBK); American Bio Medica Corporation (ABMC); American Bio Medica Corporation WTS (ABMCW); American Community Bancshares, Inc. (ACBA); American Community Bancshares (ACBAW); American Medical Alert Corporation (AMAC); American Physicians Service Group, Inc. (AMPH); American Technology Corporation (ATCO); American Vantage Companies (AVCS.OB); Amerigon Incorporated, Inc. (ARGN); Ames National Corporation (ATLO); Amistar Corporation (AMTA. PK); Ampal-American Israel Corporation (AMPLP); Angeion Corporation (ANGN); Anglo-American PLC ADR (AAUK); Applied Digital Solutions, Inc. (ADXS); Applied Imaging Corporation (AICXE); Applix, Inc. (APLX); Arlington Hospitality, Inc. (HOST.PK); Arrowhead Research Corporation (ARWR); Arrowhead Research Corporation (ARWRW); Atlantic Realty Trust (ATLRS); Auburn National Bancorporation, Inc. (AUBN); Avistar Communications Corporation (AVSR); Axeda Systems, Inc. (XEDA.PK); Axonyx, Inc. (AXYX); BackWeb Technologies Ltd. (BWEB); Badger Paper Mills, Inc. (BPMI); BancTrust Financial Group, Inc. (BTFG); Bank of South Carolina Corporation (BKSC); Beacon Power Corporation (BCON); Benthos, Inc. (BTHS); BioDelivery Sciences International, Inc. (BDSI); BioDelivery Sciences International, Inc. WTS A (BDSIW); Bioject Medical Technologies, Inc. (BJCT); Birmer Dental Management Services, Inc. (BDMS); Bitstream, Inc. (BITS); Blue Dolphin Energy Company (BDCO); Blue River Bancshares, Inc. (BRBI); Blueflyn, Inc. (BFLY); BNC Bancorp (BNCN); BOE Financial Services of Virginia, Inc. (BSXT); Boston Life Sciences, Inc. (BLSID); Bridge Capital Holdings (BBNK); Britesmile, Inc. (BSML); Britton & Koontz Capital Corporation (BKBK); Broadway Financial Corporation (BYFC); Butler International, Inc. (BUTL); Capital Title Group, Inc. (CTGI); Cardima, Inc. (CRDM.PK); Carolina Bank Holdings, Inc. (CLBH); Cascade Bancorp (CACB); Cascade Financial Corporation (CASB); Castelle (CSTL); CCF Holding Company (CCFH); CECO Environmental Corporation (CECE); Central Federal Corporation (GCFC); Central Jersey Bancorp (CJBK); Century Casinos, Inc. (CNTY); Century Realty Trust (CRLTS); China Natural Resources, Inc. (CHNR); Chindex International, Inc. (CHDX); ChromaVision Medical Systems, Inc. (CVSN); Citadel Security Software, Inc. (CDSS); Citizens & Northern Corporation (CZNC); City Investing Company Liquidating Trust (CNVLZ); Classic Bancshares, Inc. (CLAS); ClickSoftware Technologies Ltd. (CKSW); Clinical Data, Inc. (CLDA); CoActive Marketing Group, Inc. (CMKG); Coast Financial Holdings, Inc. (CFHI); Cohesant Technologies, Inc. (COHT); Commonwealth Biotechnologies, Inc. (CBTE); Community Bank Shares of Indiana, Inc. (CBIN); Community Capital Bancshares, Inc. (ALBY); Concorde Career Colleges, Inc. (CCDC); Conolog Corporation (CNLG); Corautus Genetics, Inc. (VEGF); Cortech, Inc. (CRTQ.PK); Cost-U-Less, Inc. (CULS); Crescent Financial Corporation (CRFN); Curon Medical, Inc. (CURN); CytRx Corporation (CYTR).

To move consistently with our narrow hypothesis, there must be a rise in the market price subsequent to an acquisition, or a decline subsequent to a disposition in the days following the filing of at least two forms. Concerns of space keep me from delineating the results for each company individually, but it is clear that the narrowing of the hypothesis does produce a sharper movement with a higher percentage of correlation as compared to the initial sample.

In the initial sample, after 23.2% of the days on which filing occurred there was subsequent movement consistent with the hypothesis. With that hypothesis narrowed, there was movement on 44.4% (192 of 432) of the days.<sup>117</sup> Likewise, 24% of the transactions in the first sample showed significant movement in the days following the filing, as opposed to 29.9% in the broader sample (1048 of 3499).<sup>118</sup> Finally, after the filing of 20% of the forms in the initial sample there was consistent movement, compared with 37.7% (617 of 1637) after the

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117. Those companies that had at least one day consistent with the hypothesis (with that day(s) in parenthesis) are as follows: TFSM(1); SVN(1); EGHT(2); ASTM(1); AABC(6); ACEC(1); APII(7); ADES(4); AEGN.OB(1); AIRT(4); ALAN(4); ABVA(3); AFOP(3); AMOT(1); ALTI(1); ATGN(2); AATK(1); AMBK(3); ACBA(2); AMAC(2); AMPH(2); AVCS.OB(2); ARGN(3); ATLO(4); AMTA.PK(2); AMPLP(1); ADSX(7); AICXE(1); APLX(1); ARWR(1); AUBN(4); AVSR(3); XEDA(1); AXYX(3); BTFG(10); BKSC(1); BCON(4); BTHS(1); BDSI(3); BJCT(3); BDMS(1); BITS(1); BDCO(4); BRBI(1); BFLY(1); BNCN(2); BSXT(1); BLSID(2); BBNK(1); BSML(2); BYFC(1); BUTL(2); CTGI(2); CRDM.PK(1); CLBH(2); CACB(3); CASB(3); CSTL(6); CECE(2); GCFC(3); CJBK(1); CNTY(2); CRLTS(2); CHNR(1); CHDX(1); CVSN(3); CDSS(2); CZNC(7); CLAS(1); CLDA(1); CFHI(2); COHT(4); CBTE(1); ALBY(3); CCDC(1); CNLG(4); VEGF(2); CRTQ.PK(1); CULS(2); CRFN(2); CURN(2).

118. Those companies that had at least one transaction consistent with the hypothesis (with the amount in parenthesis) are as follows: TFSM(2); SVN(10); EGHT(6); ASTM(4); AABC(18); ACEC(3); APII(15); ADES(19); AEGN.OB(6); AIRT(65); ALAN(20); ABVA(20); AFOP(6); AMOT(9); ALTI(2); ATGN(9); AATK(6); AMBK(32); ACBA(10); AMAC(32); AMPH(6); AVCS.OB(3); ARGN(16); ATLO(8); AMTA.PK(3); AMPLP(6); ADSX(24); AICXAICX E(8); APLX(3); ARWR(3); AUBN(11); AVSR(9); XEDA(3); AXYX(9); BTFG(41); BKSC(3); BCON(18); BTHS(12); BDSI(29); BJCT(13); BDMS(3); BITS(1); BDCO(12); BRBI(3); BFLY(59); BNCN(17); BSXT(14); BLSID(10); BBNK(2); BSML(3); BYFC(2); BUTL(18); CTGI(4); CRDM.PK(1); CLBH(54); CACB(6); CASB(12); CSTL(16); CECE(6); GCFC(11); CJBK(3); CNTY(6); CRLTS(4); CHNR(2); CHDX(2); CVSN(15); CDSS(5); CZNC(90); CLAS(19); CLDA(2); CFHI(5); COHT(9); CBTE(4); ALBY(5); CCDC(6); CNLG(61); VEGF(12); CRTQ.PK(1); CULS(7); CRFN(10); CURN(5).

narrowing of the hypothesis.<sup>119</sup> Although the thought will not be followed through here, it may likely follow that if one constantly increases the number of Form 4's that would serve as a possible trigger, the percentage would rise to a corresponding degree. At some point the correlation between filing and market movement would be high enough to trade consistently on that information.

The more pressing question at this point, however, is how do these results fit into the various theories addressed in Part III?

## V. FROM THEORY TO APPLICATION

In Part III of this paper, four economic theories were discussed: the efficient market hypothesis,<sup>120</sup> the random walk theory,<sup>121</sup> noise theory,<sup>122</sup> and chaos theory.<sup>123</sup> The question presented here is whether the results found in the above studies fit into any of these theories.

The efficient market hypothesis in essence states that an active market that includes many well-informed and intelligent investors will price securities accordingly and that those prices will reflect all available information.<sup>124</sup> The weak form posits that price reflects the history of

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119. Those companies that had at least one filed form consistent with the hypothesis (with that form(s) in parenthesis) are as follows: TFSM(2); SVN(10); EGHT(6); ASTM(4); AABC(17); ACEC(3); APII(15); ADES(18); AEGN.OB(6); AIRT(6); ALAN(17); ABVA(15); AFOP(6); AMOT(7); ALTI(2); ATGN(9); AATK(6); AMBK(11); ACBA(3); AMAC(6); AMPH(4); AVCS.OB(3); ARGN(12); ATLO(5); AMTA.PK(3); AMPLP(6); ADSX(20); AICXE(4); APLX(3); ARWR(3); AUBN(11); AVSR(7); XEDA(2); AXYX(7); BTFG(41); BKSC(3); BCON(16); BTHS(4); BDSI(9); BJCT(11); BDMS(3); BITS(1); BDCO(12); BRBI(3); BFLY(2); BNCN(8); BSXT(14); BLSID(8); BBNK(2); BSML(3); BYFC(2); BUTL(8); CTGI(4); CRDM.PK(1); CLBH(7); CACB(6); CASB(12); CSTL(11); CECE(6); GCFC(11); CJBK(2); CNTY(5); CRLTS(2); CHNR(2); CHDX(2); CVSN(9); CDSS(5); CZNC(48); CLAS(3); CLDA(2); CFHI(5); COHT(8); CBTE(2); ALBY(5); CCDC(6); CNLG(13); VEGF(12); CRTQ.PK(1); CULS(4); CRFN(10); CURN(4). As was noted in the first part of the experiment, the difference in the percentage of Form 4's and transactions that fit the hypothesis is due to a single form covering multiple transactions.

120. See *supra* Part III.A.

121. See *supra* Part III.B.1.

122. See *supra* Part III.B.2.

123. See *supra* Part III.B.3.

124. The Efficient Market Hypothesis & The Random Walk Theory, <http://www.investorhome.com/emh.htm> (last visited Nov. 1, 2005).

the security, the semi-strong form states that all publicly available information is reflected in price, and the strong form states that *all* information is reflected in price. This paper addresses no points concerning the weak form – all questions presented concerned present and future prices / pricing only. The tendency of the above studies to show a correlation between Form 4 filing and market movement is not consistent with the strong form of the EMH. If all information is reflected in securities prices, there should be no movement following a Form 4 containing transactions arguably related to non-public information. The results are, however, consistent with the semi-strong form, at least superficially. Once the form is filed it becomes public information. The movement subsequent to the filing could represent the efficiency of the market in taking into account that information and correcting the previous price. While that may or may not be the actual case, there is no apparent inconsistency between the semi-strong form of the EMH and the results obtained.

Random walk theory asserts that the market is in fact efficient, but that prices move so quickly in response to new information that investors cannot buy or sell fast enough to benefit from those changes.<sup>125</sup> Even assuming that the market is efficient, the presented results do not seem to show that the movement of the market in response to new information is so rapid as to deny the possibility of profitable trading on the trigger of a certain number of filed Form 4's. Even when the subsequent movement was quick, if the trader knew what to look for immediately (i.e. monitored the filing of Form 4's), the possibility of profit was very real. The only open question is what percentage of the time trading would actually result in a benefit, but that is not a question that goes to the legitimacy of the theory itself. At least theoretically, it would be possible to benefit from trading premised on the Form 4 filing requirements; thus, the random walk theory is inconsistent with the results obtained.

Noise theory posits the existence of pricing influences that are not associated with rational expectations about the underlying value of the asset.<sup>126</sup> Although I am sympathetic to this theory and believe there is a significant amount of truth in its underlying concepts, it is not applicable here. In the first instance, the actual Form 4 transactions are rational,

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125. See Hazen, *supra* note 56, at 157.

126. See Langevoort, *supra* note 33, at 854.

because the officers, directors, or 10% shareholders undertaking them certainly have expectations based on the underlying value of the asset in question. Additionally, any market movement subsequent to these filings and transactions is certainly also based on rational expectations. If the Board of a corporation began buying up large amounts of stock, or, conversely, started off-loading large amounts, it would be a rational belief that something was going on. Although it seems clear that there is a great deal of less-than-rational trading occurring in today's markets, the movement associated with this comment is not a product of, or analyzable under, noise theory.

Finally, much like noise theory, chaos theory is critical of the EMH's simplistic informational approach, and suggests that the factors affecting market pricing are significantly more complicated.<sup>127</sup> While that may be the case, this paper is not squarely on point, and consistency (or non-consistency) with chaos theory cannot be assumed. However, if the movement "found" here is premised on Form 4 filing requirements, which are possible products of non-public information, then the ability to map market movement as a non-random model in the non-linear spirit of chaos theory, could provide evidence of underlying order and predictability, and could create better rationales for corporate and insider disclosure. Chaos theory provides evidence of the lingering effects such information has on the markets; thus, making disclosure extremely important.<sup>128</sup>

As has been seen, the results found herein are not entirely inconsistent with traditional theoretical approaches to capital markets; however, they represent a different way of examining possible influences on the movements of those markets.

## VI. CONCLUSION

In concluding, it is important to be clear about both what has and what has not been accomplished by the foregoing. This comment is a general attempt to discern a market movement based on the traditional securities law maxim of "disclosure." By taking note of what exactly is being filed and the transactions on which the filings are based, a non-insider steps slightly closer to that point in time where profit becomes

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127. See Smith, *supra* note 84, at 784.

128. See Cunningham, *supra* note 66, at 855-56.

more accessible to the trader. This comment *tends* to show that there is such a movement – that either the market moves as a factor of the information made public through the filings, or the filings themselves are indicative of a future movement. What this paper certainly does not do is establish such movement as fact. In order to do that, terms must be further defined and parameters set. For instance, what is really meant by movement? In the present case it has a subjective tint – the market moves consistently with the hypothesis if that’s what I see. A solid empirical study would define movement in terms of percentage, perhaps by requiring a 5% change in price one way or the other before any significance could be imparted. Also, such a study would take into account external factors, noise, and any underlying or inherent “randomness.”

In the end, this comment represents merely the foundation of possibility. The ideas are introductory and general, but capable of being built upon. What has been accomplished, then, is the erection of the ground floor, a point of departure for future study on a topic that has received little independent attention.